Short communication

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Carfentrazone and pinoxaden with and without surfactant against grasses and broad-leaf weeds in wheat

S.S. Punia* and Dharambir Yadav

Department of Agronomy, CCS HAU, Hisar, Haryana 125 004

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Wheat crop is infested with both grassy and broad-leaf weeds. Competition from weeds throughout the crop season culminates yield losses ranging from 10 to 70% depending upon time and intensity of weed flora. In South-Western Haryana, infestation of *Avena ludoviciana* is increasing at an alarming rate in wheat due to use of high inputs like fertilizers and irrigations. In North-Eastern Haryana, wheat crop grown mainly after rice is infested with *Phalaris minor* along with broad-leaf weeds such as *Rumex dentatus, Anagallis arvensis, Chenopodium album, Convolvulus arvensis* and *Malva parviflora.* So there was urgent need for broad spectrum herbicides which can provide effective control of both grassy as well as broad-leaf weeds in wheat crop.

A post-emergence herbicide pinoxaden at 40-60 g/ha was recored very effective against *Avena ludoviciana* and resistant population of *P. minor* without any phytotoxicity to wheat crop (Yadav *et al*. 2009). For control of broad-leaf weeds, metsulfuron and 2,4-D are being widely used, but these herbicides do not provide any control of *C. arvensis, Solanum nigrum* and *Malva parviflora* for which carfentrazone is very effective (Punia *et al*. 2006, Walia and Singh 2006). Therefore to find out effective herbicide combination for complex weed flora, the present investigation was planned with the objectives to evaluate the efficacy of carfentrazone and pinoxaden with and without surfactant against grasses and broad-leaf weeds in wheat crop.

Experiment was conducted during *Rabi* seasons of 2008-09 and 2009-10, at Agronomy Research Area of CCS Haryana Agricultural University, Hisar. The experimental soil was sandy loam (Typic Ustochrepts) with 61% sand, 22.1% silt and 19.1% clay, with 0.29% organic carbon and pH of 8.2. Wheat variety *'PBW 343'* was drilled on November 18, 2008 and December 10, 2009 in a plot size of 7.0 x 4.2 m^2, by using seed rate of 100 kg/ha. The study was arranged in randomized block design and replicated thrice. Recommended dose of fertilizers and irrigations were applied uniformly in all plots. The treatments comprising of pinoxaden (5 EC) at 30, 35 and 40 g/ha and carfentrazone along with 1% ammonium sulphate applied at 15, 20 and 25 g/ha as sequential application 7 days before or after pinoxaden use were applied at 35 and 42 DAS by flat fan nozzle at a volume of 375 L/ha of water (Table 1). Additional treatments of carfentrazone 25 g *fb* pinoxaden 50 g/ha and pinoxaden 50 g/ha *fb* carfentrazone 25g along with 1% ammonium sulphate were also included during second year.

Observations for weed population and their dry matter accumulation were recorded at 60 DAT with the help of random quadrate (0.5 x 0.5 m) at four places in each plot and then converted into per m^2. Data was subjected to square root ($\sqrt{x+1}$) transformation to normalize their distribution before analysis. Data on per cent visual control by herbicides recorded on 0-100 scale was transformed by using arcsin transformation method and data on yield attributes and grain yield of wheat was also recorded at harvest which was statistically analyzed using analysis of variance.

The experimental field was infested with natural population of grassy (84% and 87%) and broad-leaf weeds (16% & 13%), respectively during both the 2008-09 and 2009-10, respectively. The dominant weeds were little seed canary grass (*Phalaris minor* Retz.) among grassy weeds and *Chenopodium album* L., *Convolvulus arvensis* and *Melilotus indica* among broad-leaf weeds. Density and dry weight of different grassy and broad-leaf weeds were significantly affected by herbicides treatments as compared to untreated check at 30 days after application (Table 1). Although, pinoxaden at the all doses provided excellent control of grassy weeds but did not show any efficacy against broad-leaf weeds (Table 1). Efficacy of herbicide on grassy and broad-leaf weeds increased significantly with increasing the dose of pinoxaden and

***Corresponding author:** puniasatbir@gmail.com

Table 1. Effect of different herbicide doses on density and dry weight of weeds, and grain yield of wheat (2008-09 and 2009-10)

Treatment	Weed density (no./m^2) at 60 DAT					Weed dry weight (g/m^2) at 60 DAT	
	2008-09		2009-10				
	P. minor	*C. album*	*P. minor*	*C. album*	*Convolvulus arvensis*	2008-09	2009-10
Carfentrazone 15 g *fb* pinoxaden 30 g/ha	1.3(0.7)	1.5(1.3)	3.0 (8.2)	1.8 (2.3)	1.9 (2.7)	137.3	120.7
Carfentrazone 20 g *fb* pinoxaden 35 g/ha	1.4(1.0)	1.3(0.7)	2.7 (6.3)	1.3 (0.7)	1(0)	133	88.7
Carfentrazone 25 g *fb* pinoxaden 40 g/ha	1.3(0.7)	1(0)	1.5(1.3)	1.3(0.7)	1(0)	62.7	56.3
Carfentrazone 25 g *fb* pinoxaden 50 g/ha	-	-	1(0)	1(0)	1(0)	-	44.0
Pinoxaden 30 g/ha *fb* Carfentrazone 15 g (ammonium sulphate 1%)	1.1(0.3)	1.1(0.3)	3.2(9.4)	1.6(1.7)	1.8(2.3)	232	99.3
Pinoxaden 35 g/ha *fb* Carfentrazone 20 g (ammonium sulphate 1%)	1.3(0.7)	1.1(0.3)	2.6(5.6)	1.3(0.6)	1(0)	128	68.0
Pinoxaden 40 g/ha *fb* Carfentrazone 25 g (ammonium sulphate 1%)	1(0)	1(0)	1.5(1.3)	1(0)	1(0)	0	38.0
Pinoxaden 50 g/ha *fb* carfentrazone 25 g (ammonium sulphate 1%)	-	-	1(0)	1(0)	1(0)	-	35.3
Carfentrazone 25 g/ha	2.6(5.6)	1(0)	7.0(48.2)	1(0)	1(0)	592.6	323.3
Pinoxaden 40 g/ha	1.1(0.3)	2.9(4)	1.5(1.3)	2.7(6.3)	2.3(4.3)	177.3	94.3
Weed free	1.0(0)	1(0)	1(0)	1(0)	1(0)	0	0.0
Weedy check	6.5(42)	2.3(4.3)	7.3(52)	2.7(6.3)	2.4(5.0)	602.6	400.3
LSD (P=0.05)	0.91	0.32	1.2	0.37	0.42	9.3	16.5

Original values are in parentheses

Table 2. Effect of different herbicide combinations on weed control efficiency and grain yield of wheat (2008-09 and 2009-10)

Treatment	Weed control efficiency (%)		Grain yield (t/ha)	
	2008-09	2009-10	2008-09	2009-10
Carfentrazone 15 g *fb* pinoxaden 30 g/ha	77.2	69.8	4.29	3.61
Carfentrazone 20 g *fb* pinoxaden 35 g/ha	77.9	77.8	4.50	3.79
Carfentrazone 25 g *fb* pinoxaden 40 g/ha	89.5	85.9	4.60	3.78
Carfentrazone 25 g *fb* pinoxaden 50 g/ha	89	89	4.06	4.06
Pinoxaden 30 g/ha *fb* carfentrazone 15 g (Ammonium sulphate 1%)	78.1	75.1	4.36	3.87
Pinoxaden 35 g/ha *fb* carfentrazone 20 g (Ammonium sulphate 1%)	78.7	83.0	4.42	3.84
Pinoxaden 40 g/ha *fb* carfentrazone 25 g (Ammonium sulphate 1%)	100	90.5	4.85	3.91
Pinoxaden 50 g/ha *fb* carfentrazone 25 g (Ammonium sulphate 1%)	75.1	91.1	3.87	4.18
Carfentrazone 25 g/ha	1.2	19.2	4.13	3.67
Pinoxaden 40 g/ha	70.5	76.4	4.55	3.85
Weed free	100	100	4.83	4.00
Weedy check	0.0	0.0	3.83	3.41
LSD (P=0.05)	2.6	2.6	0.14	0.29

carfentrazone during both the years of investigation. Application of carfentrazone at 25 g/ha provided complete control of broad-leaf weeds. As shown by WCE (%), sequential application of pinoxaden at 40 g/ha *fb* carfentrazone 25 g/ha and adding ammonium sulphate proved significantly effective in reducing density and biomass of weeds and gave 100% control of grassy and broad-leaf weeds without any phytotoxic effect on crop during 2008-09 while during 2009-10, sequential application of pinoxaden at 50 g/ha with carfentrazone 25 g/ha along with 1% of ammonium sulphate gave complete control of grassy and broad-leaf weeds without any phytotoxic effect on wheat crop (data not given). This is in conformity with earlier findings of Katara *et al.* (2013) and Shoeran *et al.* (2013). During first year, use of carfentrazone 25 g/ha at 35 DAS and pinoxaden 40 g/ha at 7 days after carfentrazone use was not as effective against the *P. minor* as pinoxaden use at 35 days after sowing but application of carfentrazone 25 g/ha at 35 DAS and sequential application of pinoxaden 40 and 50 g/ha at 7 days after carfentrazone use was equally effective against *P. minor* as pinoxaden used at 35 days after sowing.

All the herbicide treatments registered significantly higher crop yield over weedy check during both the years of experimentation (Table 1 and 2). Presence of weeds throughout crop season reduced wheat yield by 20.6 and 14.8% as compared to weed free situations in 2008-09 and 2009-10, respectively. During 2008-09, maximum grain yield (4.85 t/ha) was recorded with the application of pinoxaden at 40 g/ha (35 DAS) *fb* sequential application of carfentrazone 20 g/ha (42 DAS) with 1% solution of ammonium sulphate which was at par with weed free check and significantly superior to all other herbicide treatments while during 2009-10, maximum grain yield (4.18 t/ha) was recorded with the application of pinoxaden at 50 g/ha (35 DAS) with sequential use of carfentrazone 25 g/ha (42 DAS) along with 1% solution of ammonium sulphate which was at par with combination of pinoxaden 40 g/ha *fb* carfentrazone 25 g (ammonium sulphate 1%), carfentrazone 25 g *fb* pinoxaden 50 g/ha which was even 4.5% higher than weed free check.

The present investigation conclusively inferred that post-emergence application of pinoxaden 40 g/ha at 35 DAS and carfentrazone 25g/ha at 42 DAS is very effective to control grassy as well as broadleaf weeds without any injury to wheat crop.

SUMMARY

Experiment to evaluate the bioefficacy of pinoxaden 5 EC in combination with carfentrazone in wheat was conducted in sandy loam soil at CCS HAU Hisar during *Rabi* seasons of 2008-09 and 2009-10, at Agronomy Research Area of CCS Haryana Agricultural University, Hisar. The dominant weeds present in experimental field were little seed canary grass (*Phalaris minor* Retz.) among grassy weeds and *Chenopodium album*, *Convolvulus arvensis* and *Melilotus indica* among broadleaf weeds. Use of carfentrazone 25 g/ha at 35 DAS and pinoxaden 40 g/ha 7 days after carfentrazone use was not as effective against *P.minor* as pinoxaden use at 35 days after sowing. Post-emergence use of pinoxaden at 50 g/ha (35 DAS) with sequential use carfentrazone at 25 g/ha (42 DAS) with 1% ammonium sulphate provided complete control grassy and broadleaf weeds without any phytotoxic effect on wheat crop.

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